



Department of
Environmental
Conservation

DFS Webinar Series Physical Climate Risks in New York State: Part 2, Coastal Hazards



Mark Lowery

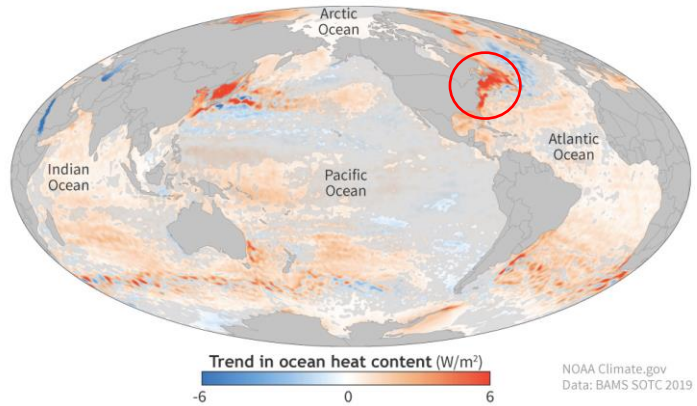
Assistant Director

Office of Climate Change

New York State Department of Environmental Conservation

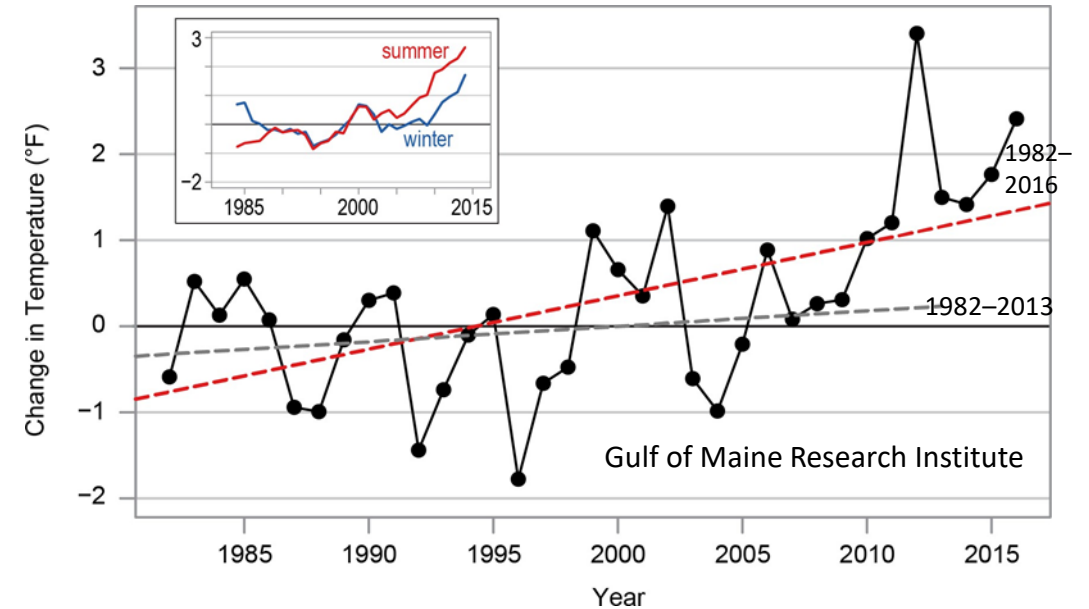
Sea-surface Temperature (likely)

CHANGE IN OCEAN HEAT CONTENT (1993-2019)



- Northeast Continental Shelf warming faster than global average
 - Trend will continue
- Vulnerabilities:
 - Harmful algal blooms, e.g., red tide
 - Fish, crustacean, mollusk population shifts

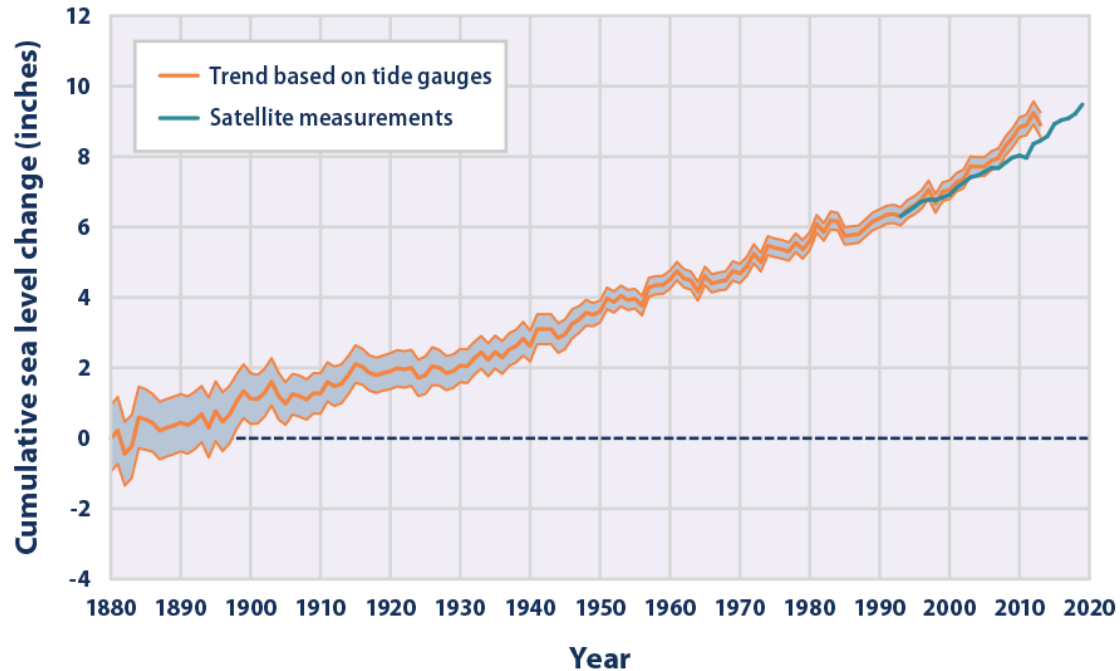
Sea-surface Temperature Anomalies, Northeast Continental Shelf



- Changes in ocean circulation patterns, nutrient availability
- Influence storm tracks, atmospheric moisture

Global Sea-level Rise

Global Average Absolute Sea Level Change, 1880–2019



Data sources:

- CSIRO (Commonwealth Scientific and Industrial Research Organisation). 2017 update to data originally published in: Church, J.A., and N.J. White. 2011. Sea-level rise from the late 19th to the early 21st century. *Surv. Geophys.* 32:585–602. Accessed September 2017. www.cmar.csiro.au/sealevel/sl_data_cmar.html.
- NOAA (National Oceanic and Atmospheric Administration). 2021. Laboratory for Satellite Altimetry: Sea level rise. Accessed March 2021. www.star.nesdis.noaa.gov/sod/lisa/SeaLevelRise/LSA_SLR_timeseries_global.php.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Recent acceleration:

- 1880-2013 – 0.6 inch/decade
- Since 1993 – 1.3 inches/decade

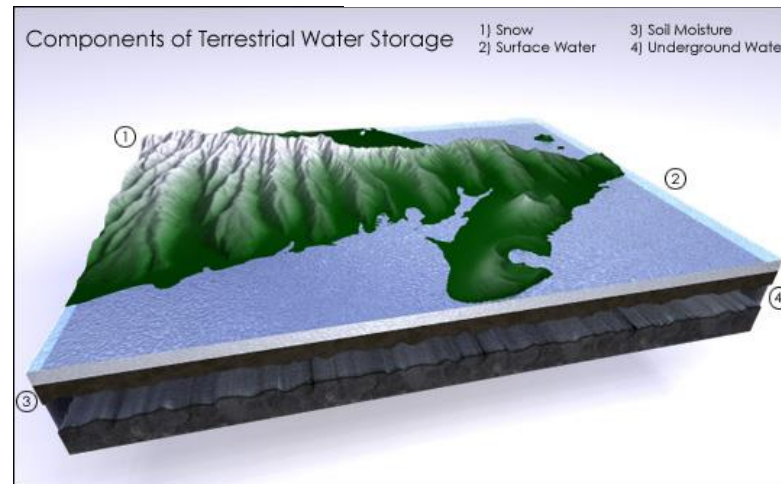
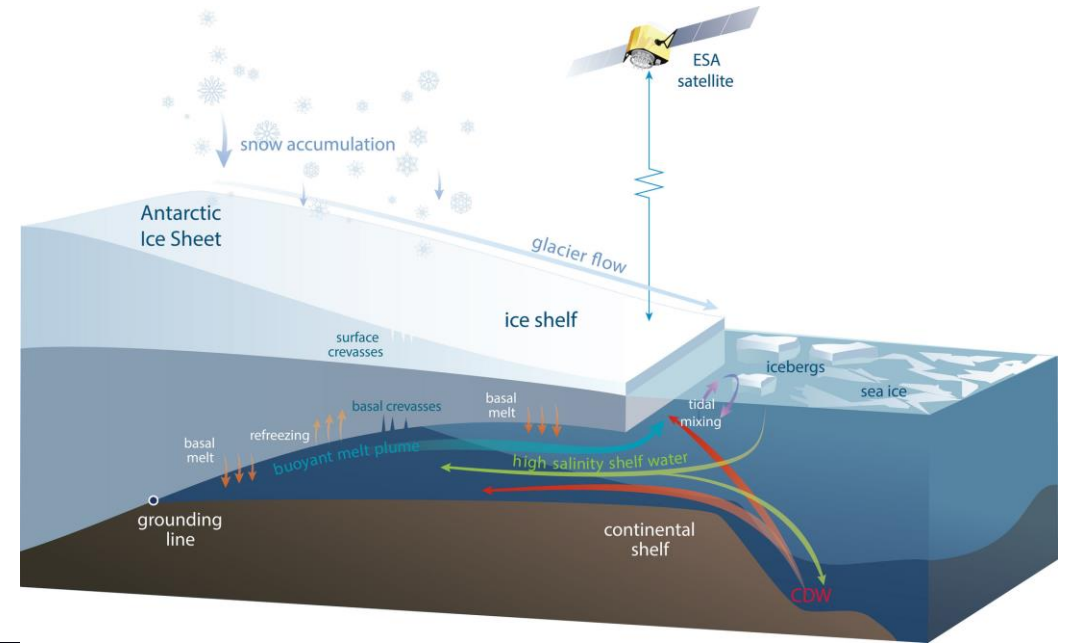


Department of
Environmental
Conservation

Physical Basis of Global Sea-level Rise

Components

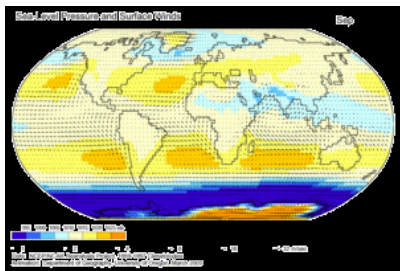
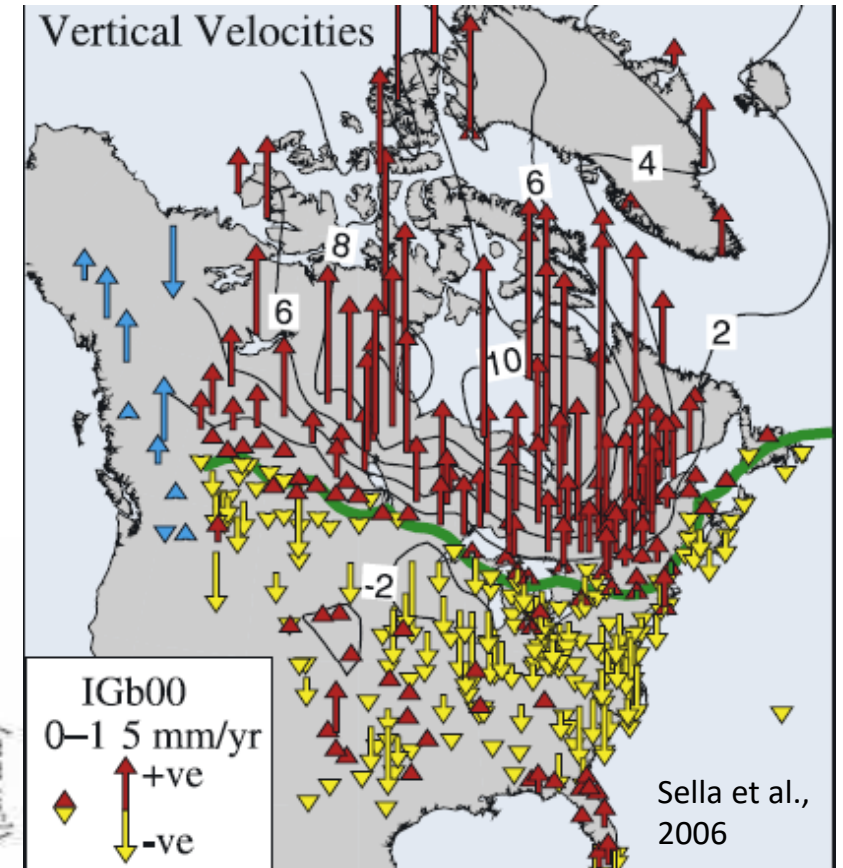
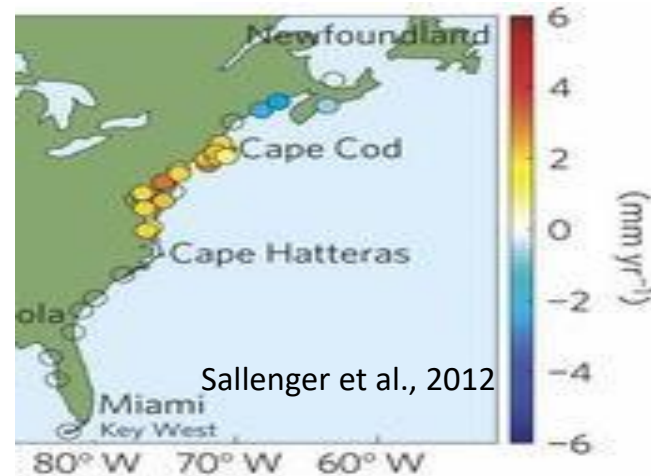
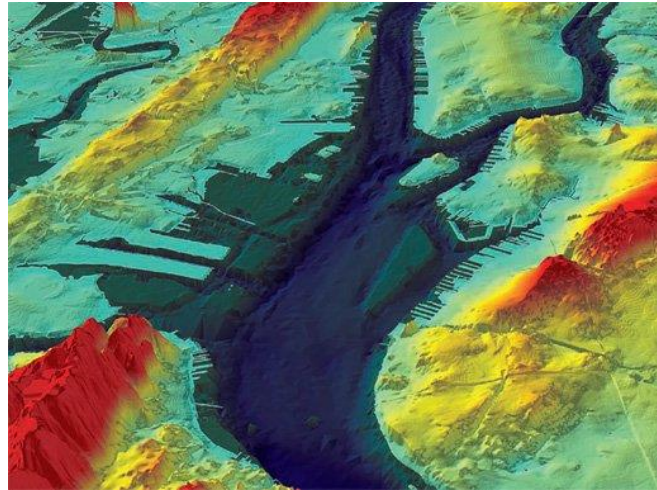
- Steric (thermal expansion)
- Ice sheet melt and dynamics (Greenland, Antarctica)
- Glacier
- Terrestrial water storage



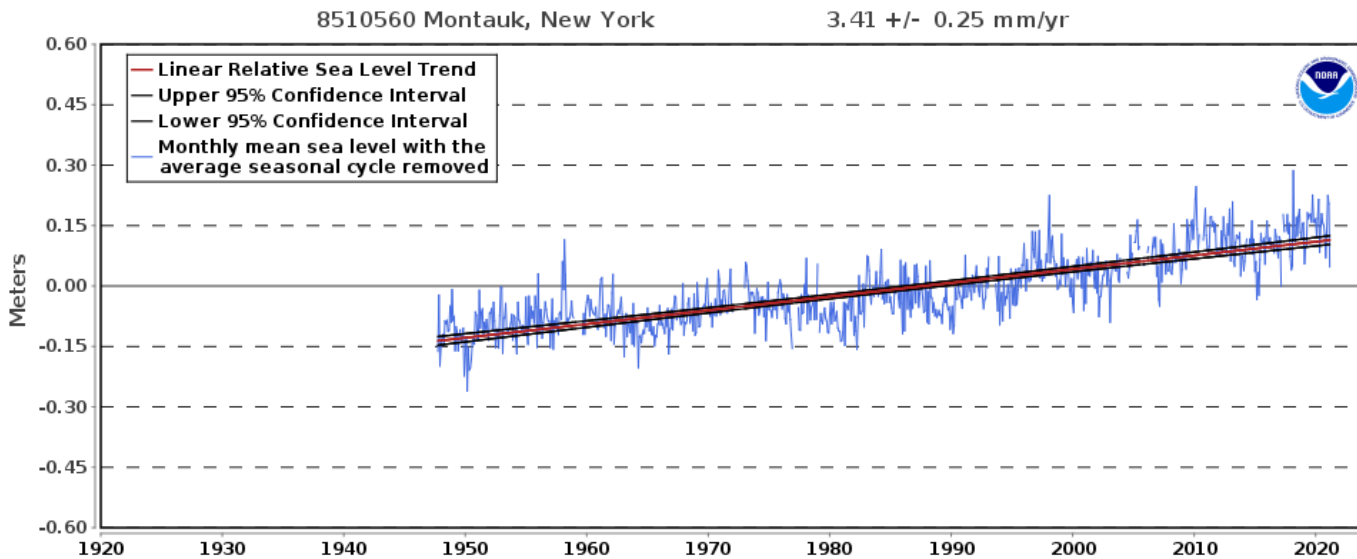
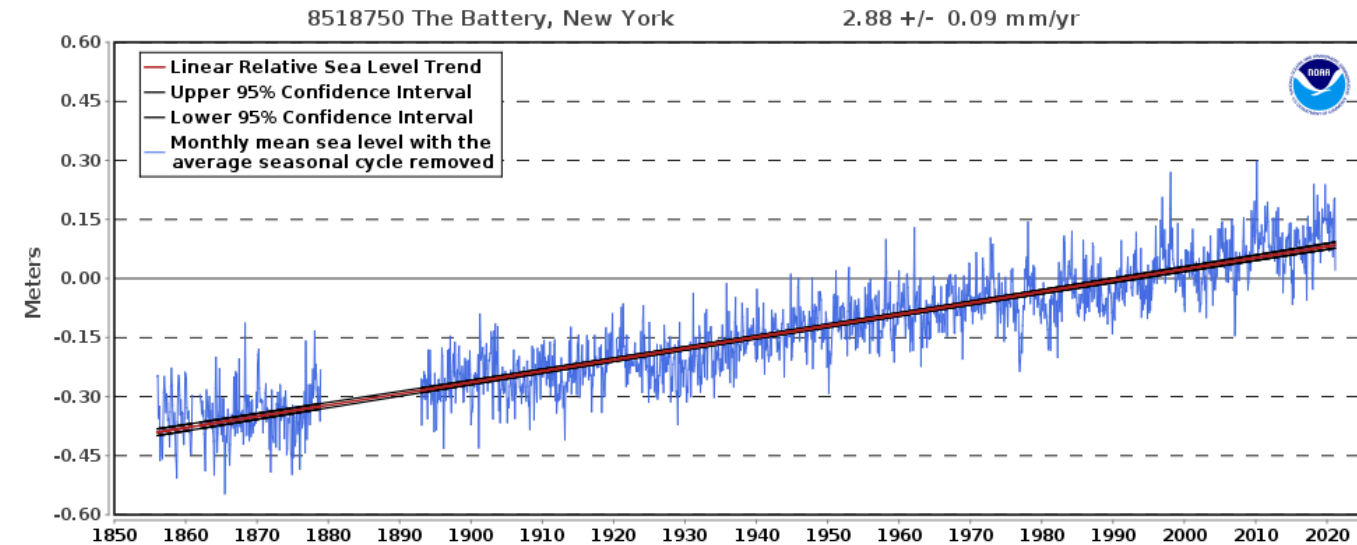
Physical Basis of Relative Sea-level Rise

Components

- Glacial isostatic adjustment
- Topography, bathymetry
- Changes in water surface elevation
- Ice loss effects (fingerprinting)
- Sea-level air pressure



New York Sea-level Rise



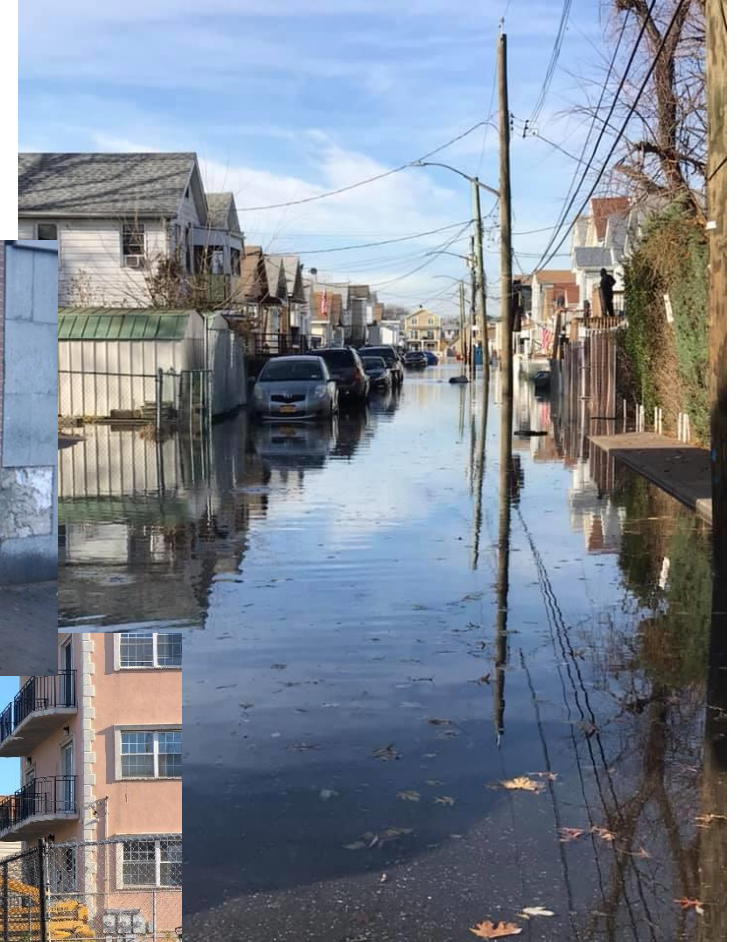
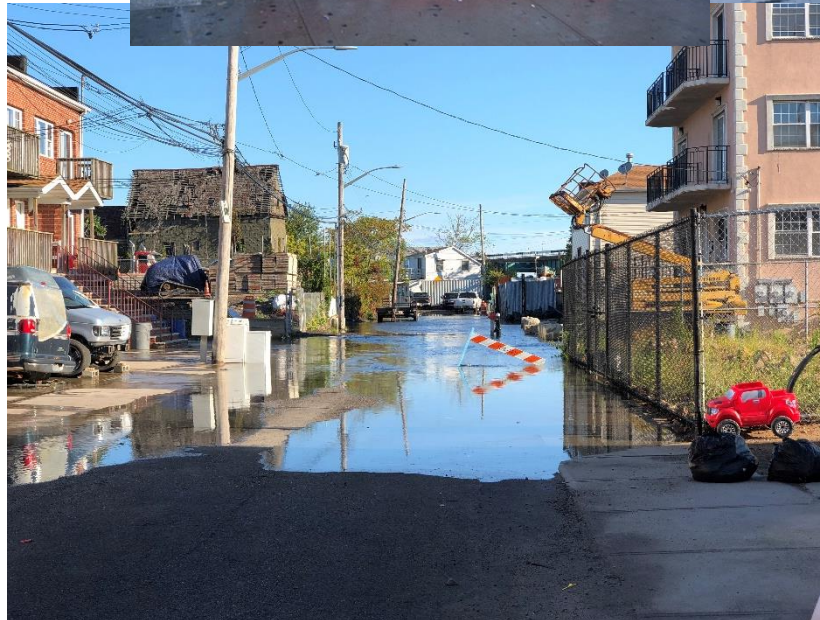
- 1.2 inches/decade
 - Almost twice global rate
- About 40% due to subsidence
 - Remainder thermal expansion current and water surface changes

<https://tidesandcurrents.noaa.gov/>

Permanent Inundation (very likely)

Sunny-day flooding

- Personal property damage
- Abandonment of homes, businesses and communities
- Loss of populated areas
- Loss of tax base
- Damage to water, energy and transportation infrastructure
- Spread of contamination

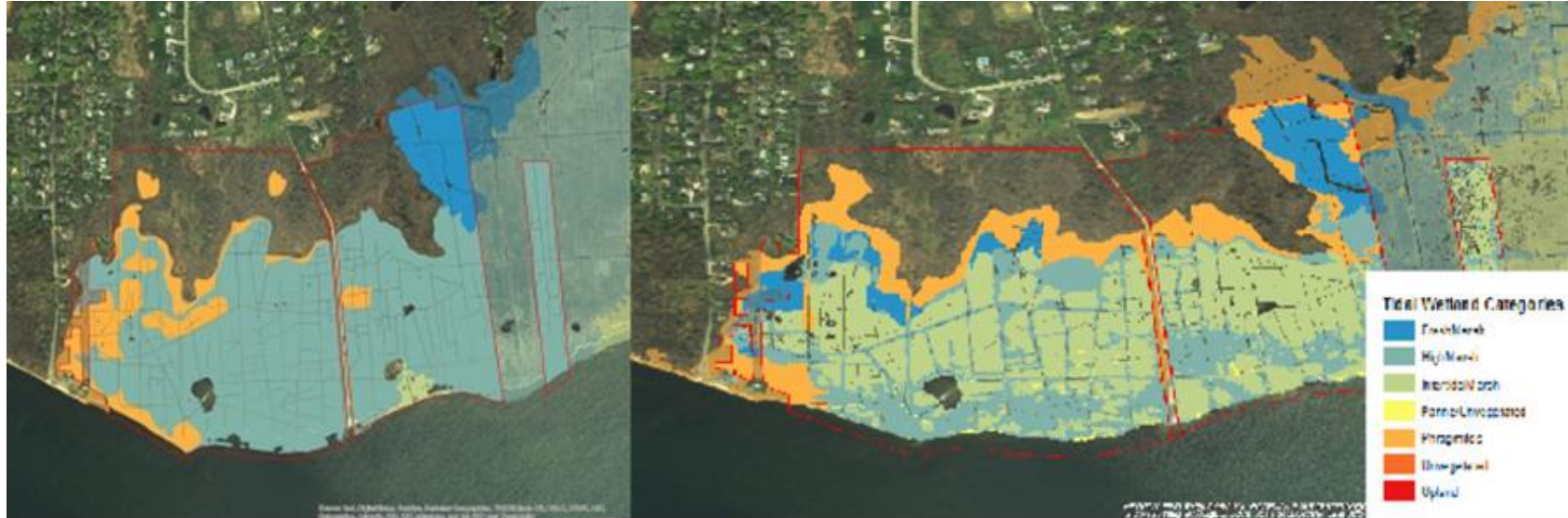


Community Flood Watch
Project NYC / SRIJB and NYSG



Department of
Environmental
Conservation

Permanent Inundations: Wetlands Loss



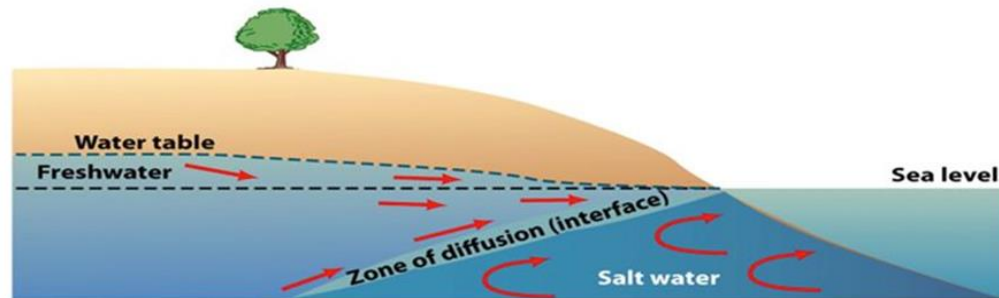
Fireplace Neck, Brookhaven: Replacement of high marsh by intertidal marsh or Phragmites from 1974 to 2008.

- Loss of beaches, coastal wetlands and salt marsh stress
- Reduced species diversity



Salt Water Intrusion

Groundwater on Long Island: saltwater intrusion

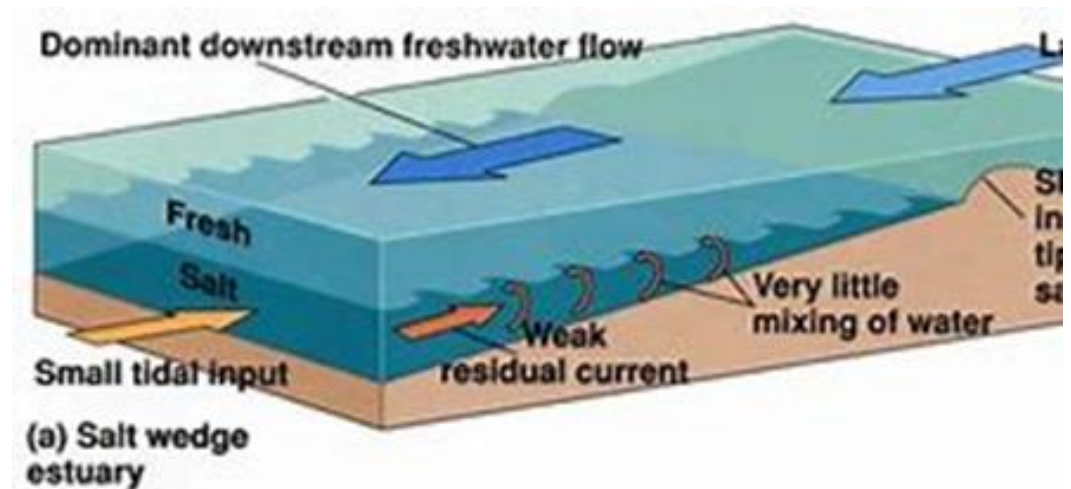


(a) Before pumping



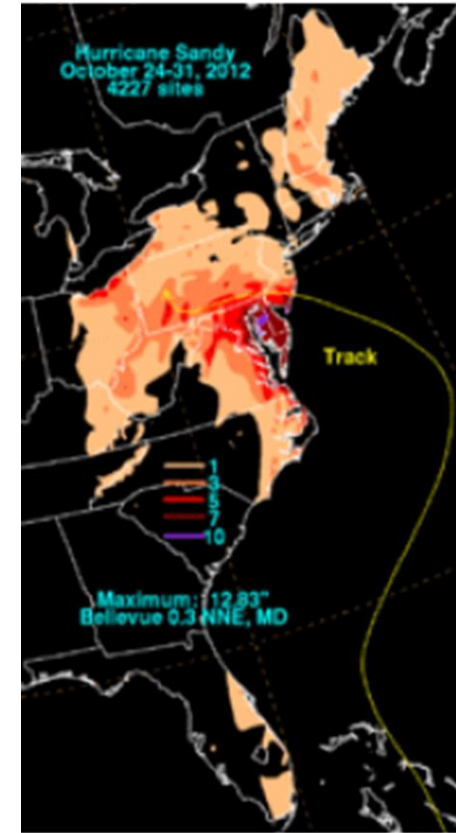
(b) After pumping

Hudson River Salt Front



Tropical Cyclones (more intense)

- Hurricanes, tropical storms
 - Typically July–October, but getting earlier
 - Storm surge, high winds, heavy rain
- Climate change effects
 - Number – uncertain
 - More intense (higher winds)
 - Wetter
 - More rapid intensification, slower decay



Nor'easters

- Nor'easters
 - September – April
 - High winds, wave action, several tide cycles
 - Potential high snowfall
 - Severe nor'easters continue
 - Future track unchanged



Sea-level Rise and Sandy

- Total damage: \$62.5 billion
- Anthropogenic sea-level rise effect:
 - \$8.1billion
 - 71,000 (9.2%) more people
 - 36,000 (8.8%) more housing units

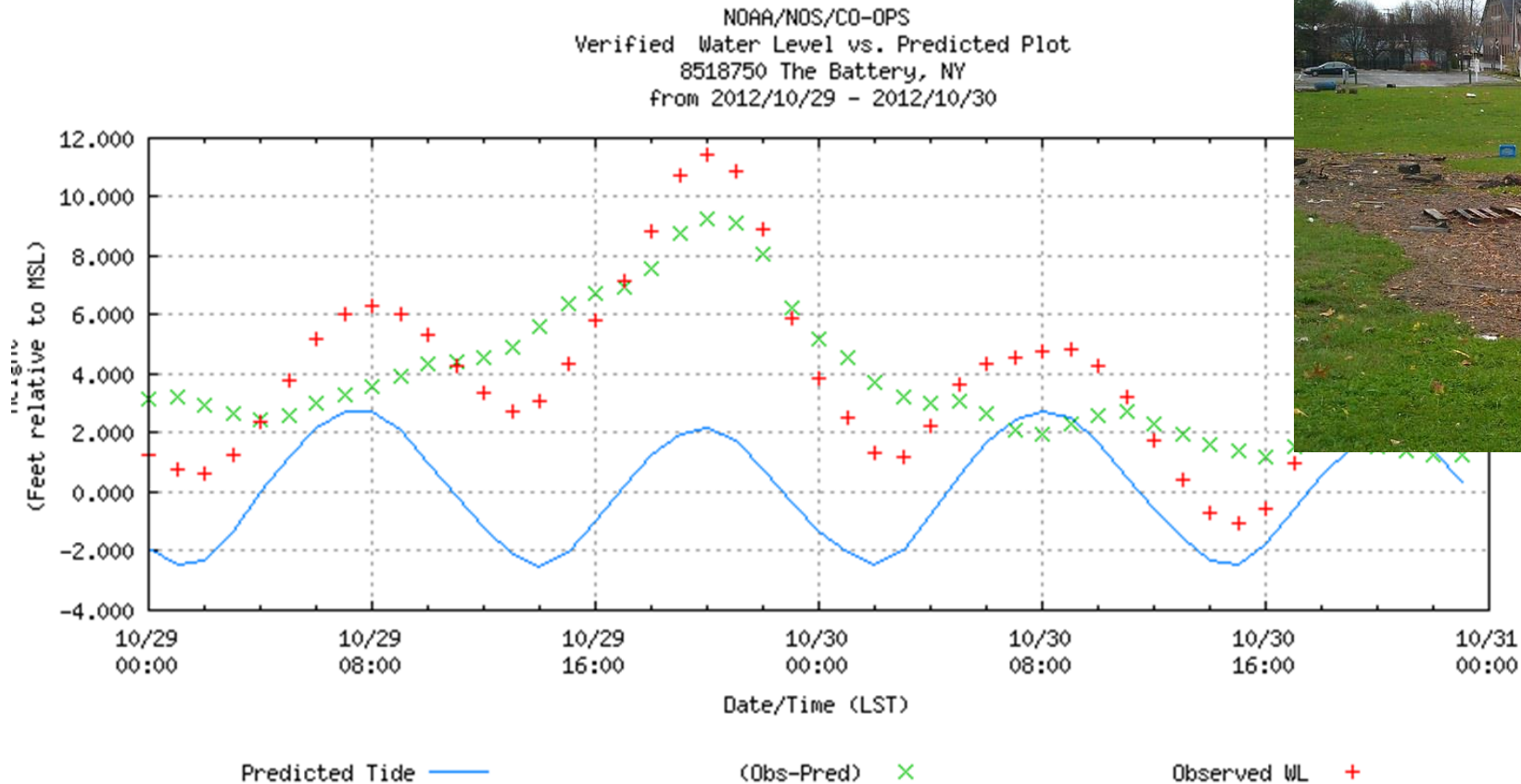


NYSDEC



Increased Storm Surge (likely/very likely)

Sandy's Surge

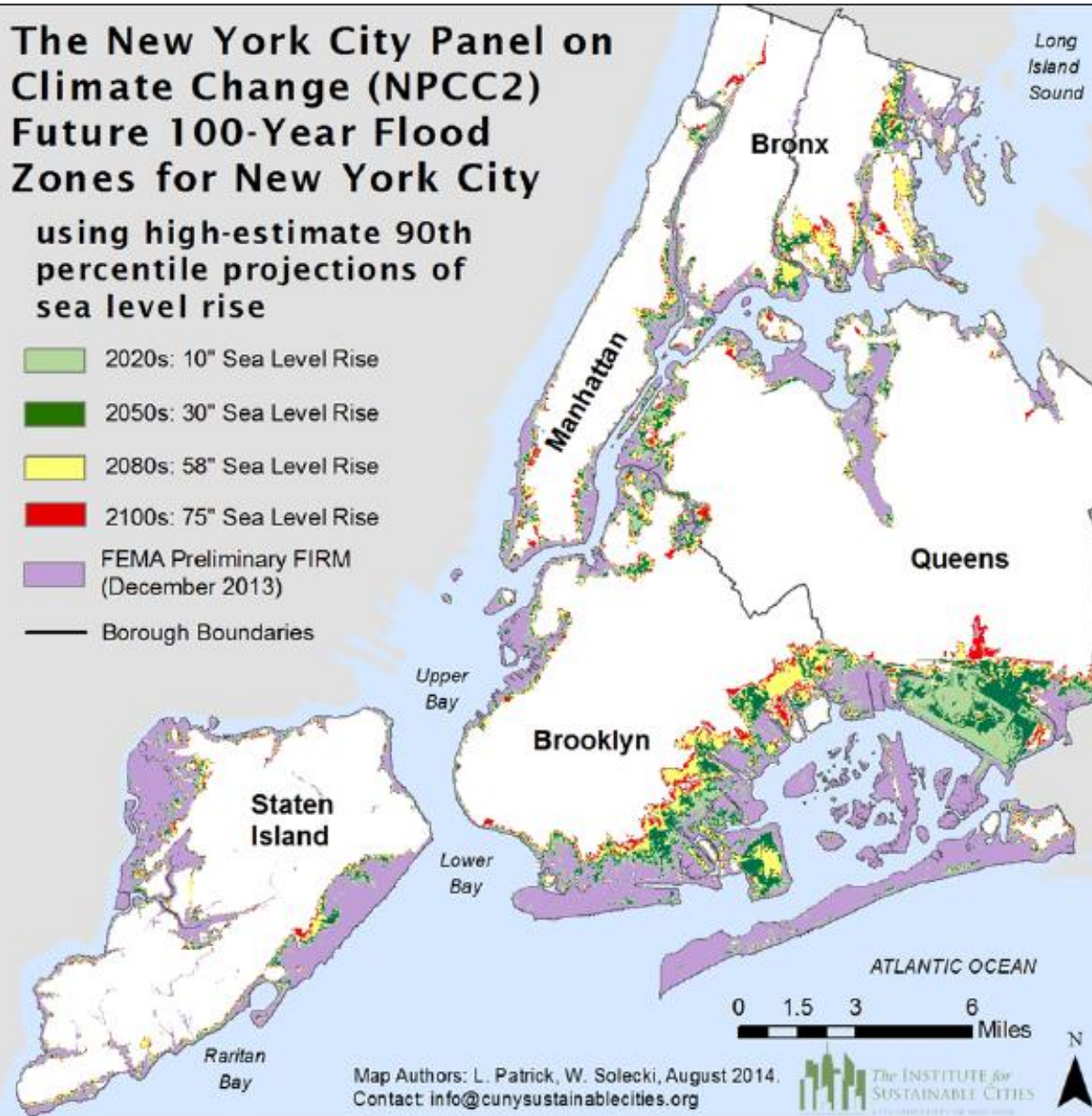


Department of
Environmental
Conservation

The New York City Panel on Climate Change (NPCC2) Future 100-Year Flood Zones for New York City

using high-estimate 90th
percentile projections of
sea level rise

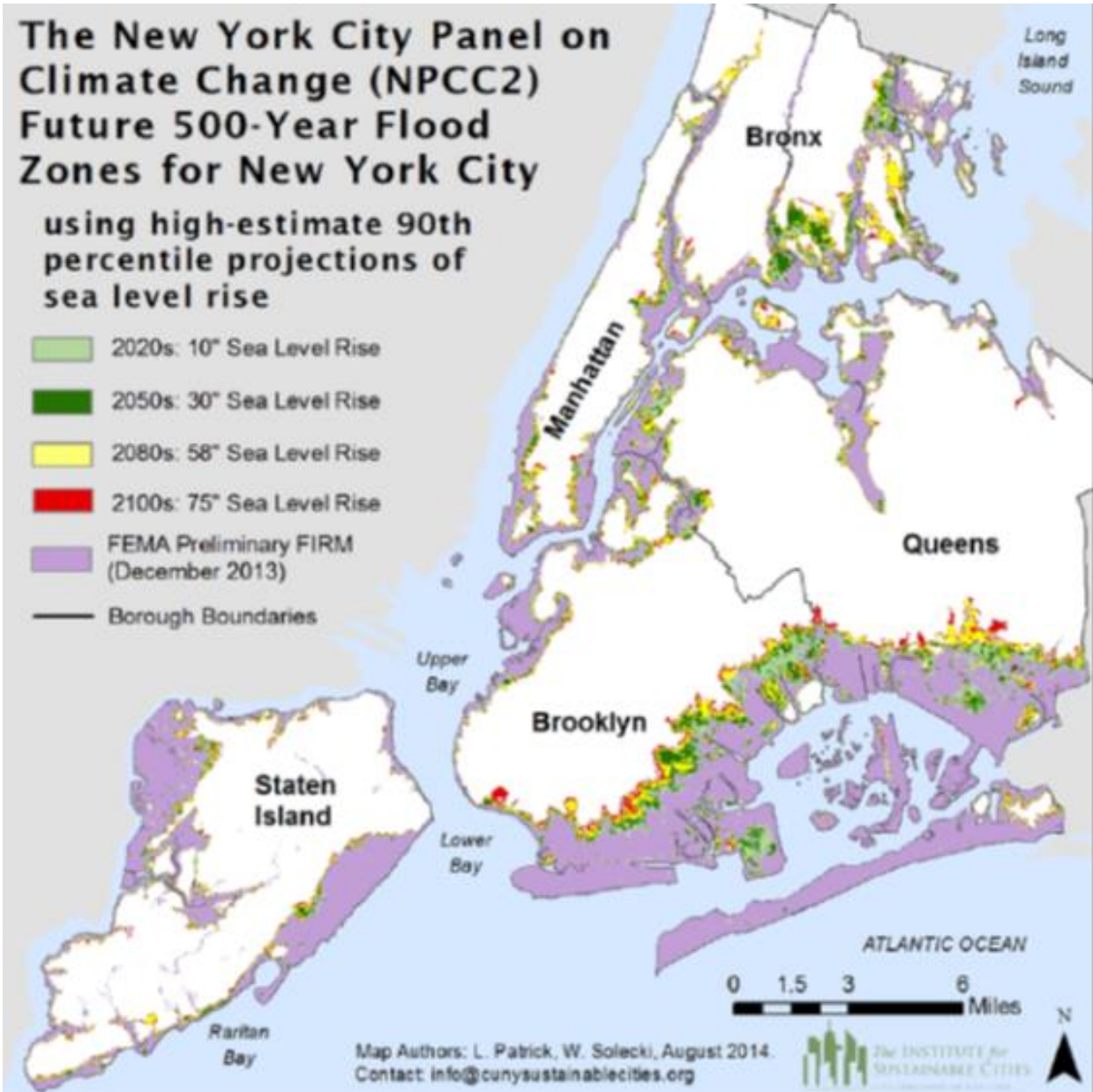
- 2020s: 10" Sea Level Rise
- 2050s: 30" Sea Level Rise
- 2080s: 58" Sea Level Rise
- 2100s: 75" Sea Level Rise
- FEMA Preliminary FIRM (December 2013)
- Borough Boundaries



The New York City Panel on Climate Change (NPCC2) Future 500-Year Flood Zones for New York City

using high-estimate 90th
percentile projections of
sea level rise

- 2020s: 10" Sea Level Rise
- 2050s: 30" Sea Level Rise
- 2080s: 58" Sea Level Rise
- 2100s: 75" Sea Level Rise
- FEMA Preliminary FIRM (December 2013)
- Borough Boundaries



Community Risk and Resiliency Act (2014)

as amended by the Climate Leadership and Community Protection Act (2019)

- Requires sea-level rise projections (DEC; adopted 2017)
- Requires consideration of climate change by applicants for major permits and in DEC facility-siting regulations
- Requires model local laws to increase resilience (DOS, DEC; released 2019)
- Requires applicants demonstrate consideration of sea-level rise, storm surge and flooding in specified funding programs
- Adds mitigation of sea-level rise, storm surge and flooding to Smart Growth Public Infrastructure Policy Act criteria
- Authorizes DEC require mitigation of significant climate risks to any natural resource, public infrastructure or services, disadvantaged communities, or private property not owned by the applicant.
- Requires guidance on implementation (DEC, DOS)
- Requires guidance on use of natural resilience measures to reduce risk (DEC, DOS)

<http://www.dec.ny.gov/energy/102559.html>



Department of
Environmental
Conservation

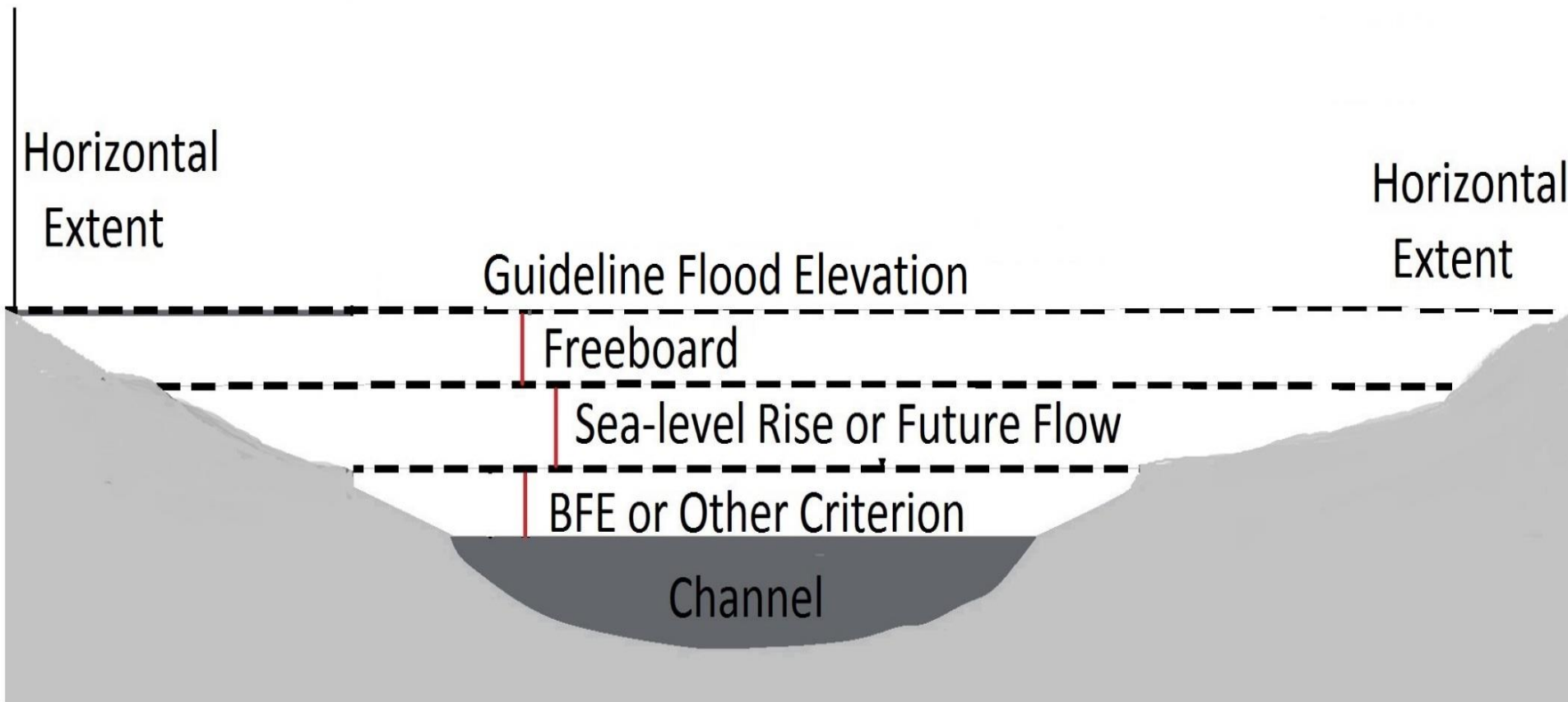
6 NYCRR Part 490 Projected Sea-level Rise

Inches of rise relative to 2000-2004 baseline

	Region	Long Island					New York City/Lower Hudson					Mid-Hudson				
	Descriptor	Low	Low-medium	Medium	High-medium	High	Low	Low-medium	Medium	High-medium	High	Low	Low-medium	Medium	High-medium	High
Time Interval	2020s	2	4	6	8	10	2	4	6	8	10	1	3	5	7	9
	2050s	8	11	16	21	30	8	11	16	21	30	5	9	14	19	27
	2080s	13	18	29	39	58	13	18	29	39	58	10	14	25	36	54
	2100	15	21	34	47	72	15	22	36	50	75	11	18	32	46	71



Climate-informed Science Flood-risk Management Guideline



Tidal Areas

- Apply specified Part 490 projection

Nontidal areas

- Apply regional design-flow multipliers

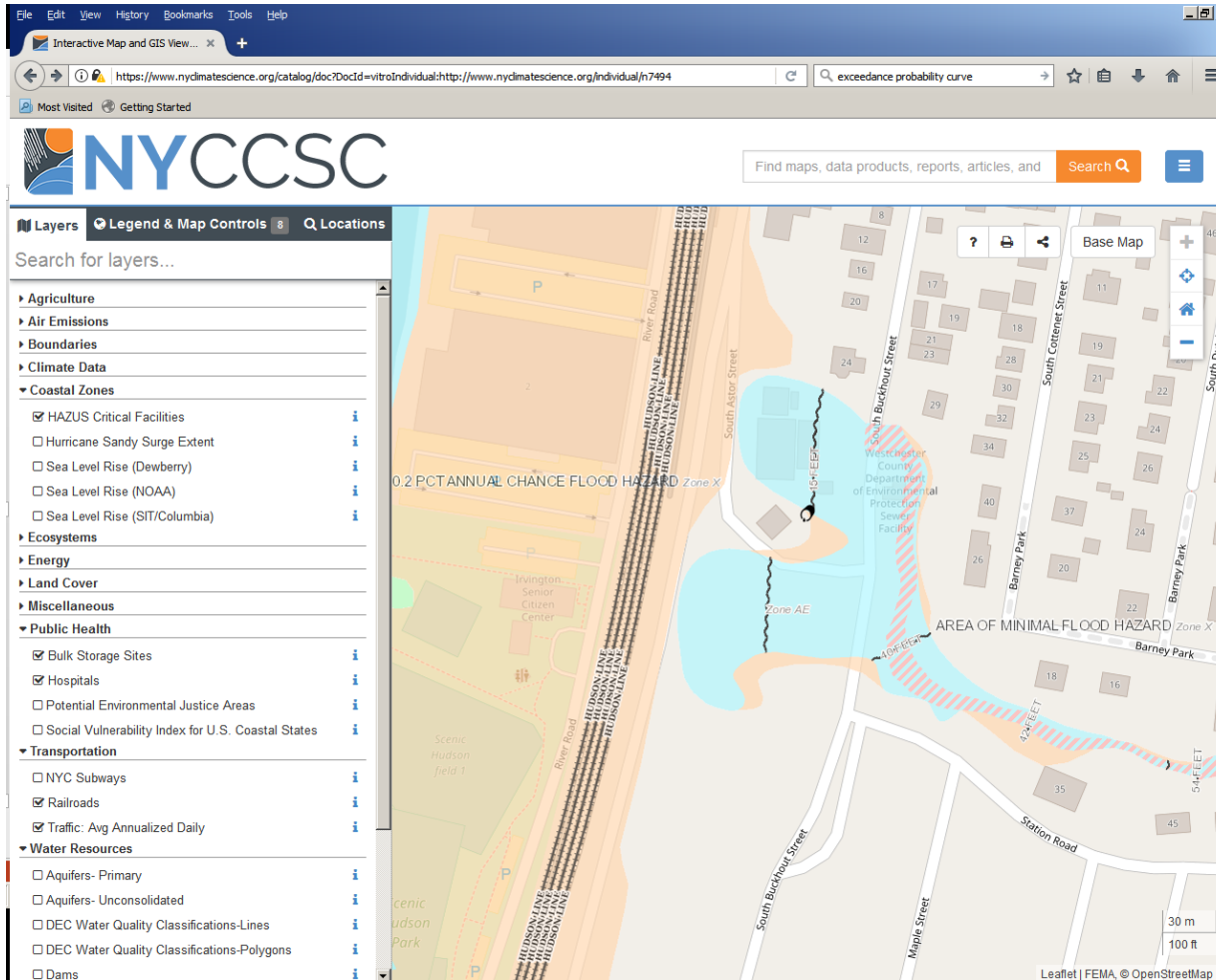
CRRA Guidance Documents

- Using Natural Measures to Reduce the Risk of Flooding and Erosion
- New York State Flood Risk Management Guidance
- Guidance for Smart Growth Public Infrastructure Assessment
- Estimating Guideline Elevations



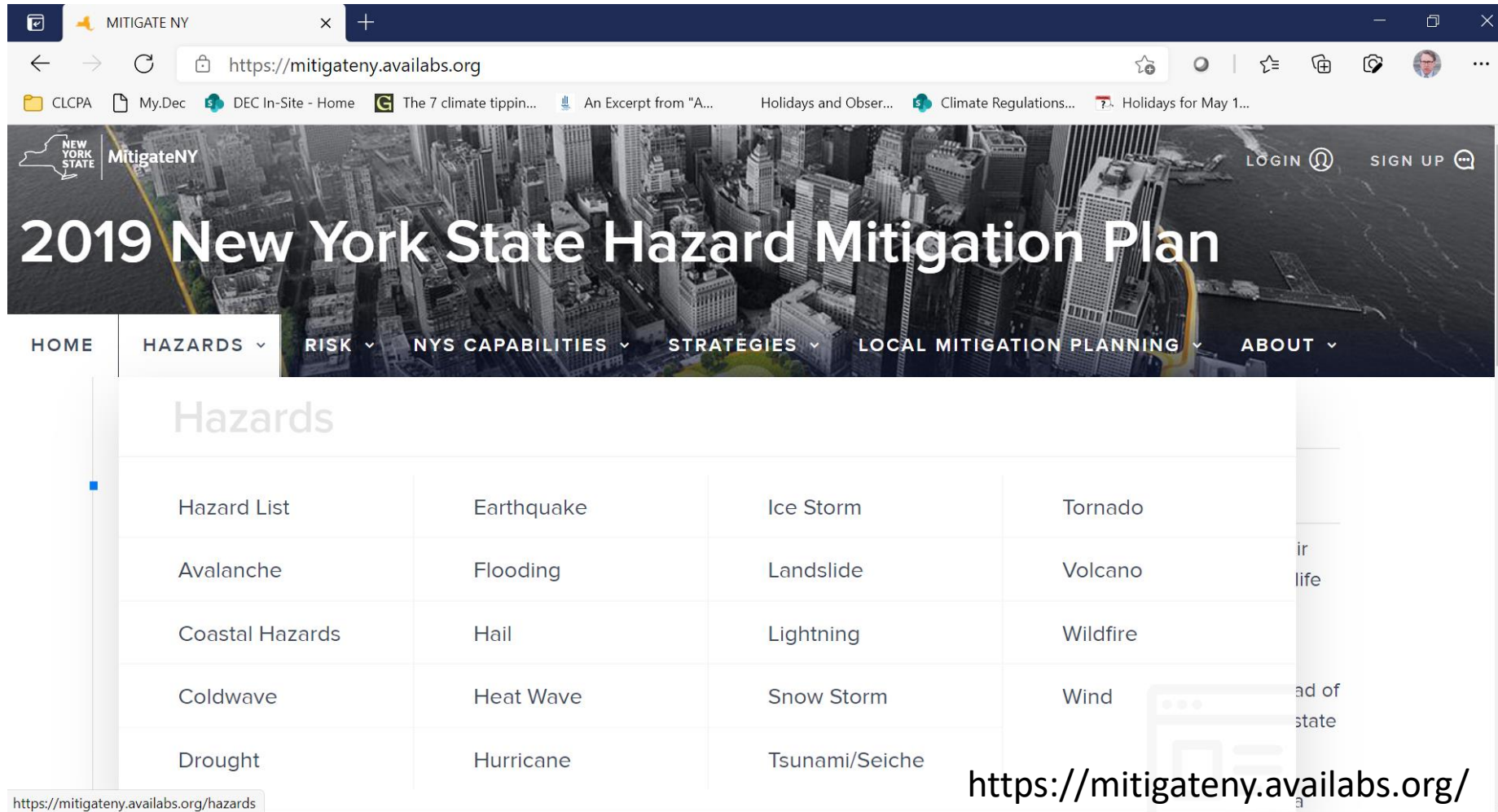
NY Climate Change Science Clearinghouse

Clearinghouse: Maps, data and documents to support decision making



<https://www.nyclimatescience.org/>

New York State Hazard Mitigation Plan



MITIGATE NY

https://mitigateny.availabs.org

CLCPA MyDec DEC In-Site - Home The 7 climate tippin... An Excerpt from "A... Holidays and Obser... Climate Regulations... Holidays for May 1...

NEW YORK STATE MitigateNY

2019 New York State Hazard Mitigation Plan

LOGIN SIGN UP

HOME HAZARDS RISK NYS CAPABILITIES STRATEGIES LOCAL MITIGATION PLANNING ABOUT

Hazards

Hazard List	Earthquake	Ice Storm	Tornado
Avalanche	Flooding	Landslide	Volcano
Coastal Hazards	Hail	Lightning	Wildfire
Coldwave	Heat Wave	Snow Storm	Wind
Drought	Hurricane	Tsunami/Seiche	

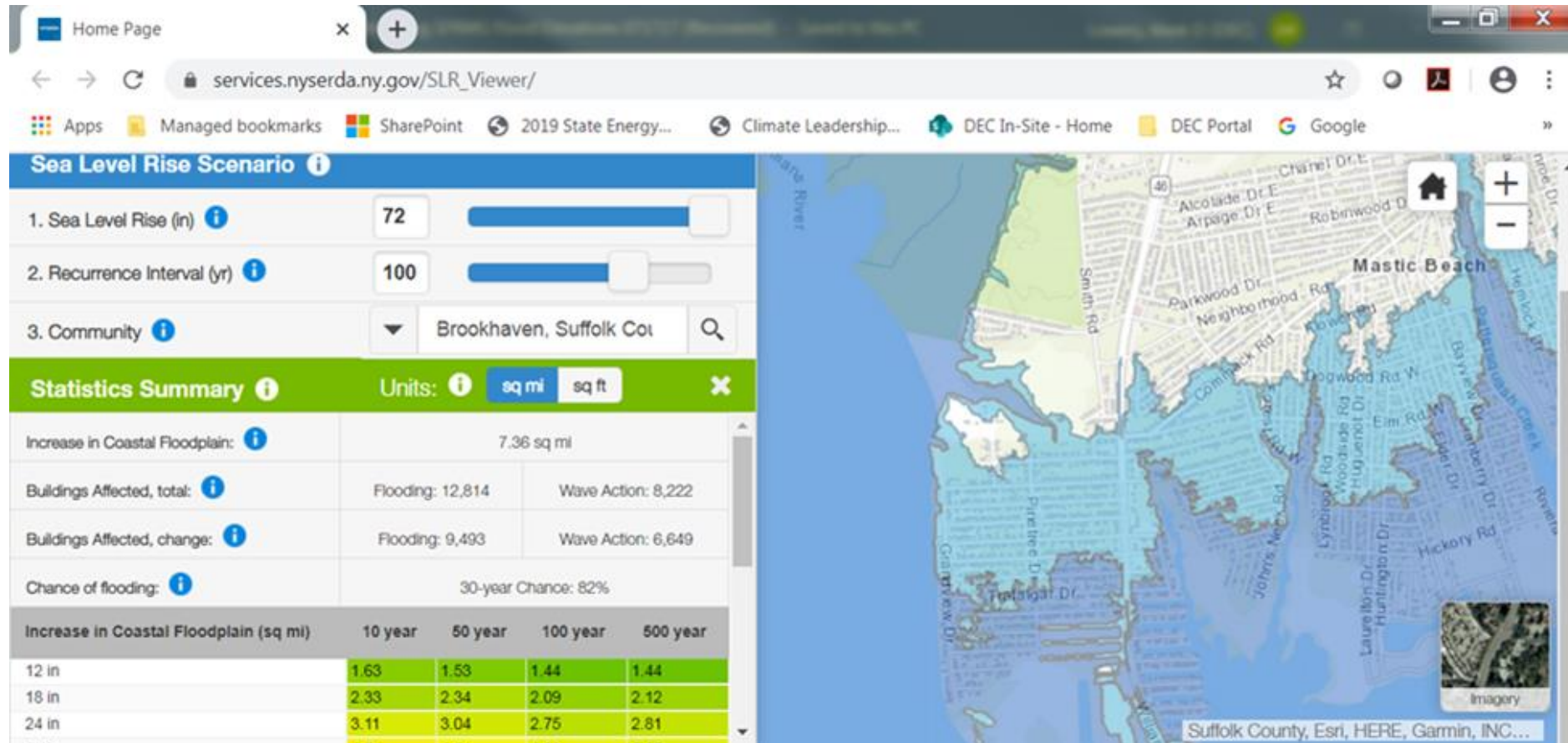
https://mitigateny.availabs.org/hazards

NEW YORK STATE OF OPPORTUNITY

Department of Environmental Conservation

https://mitigateny.availabs.org/

Sea-level Rise Viewer: Nassau and Suffolk Counties

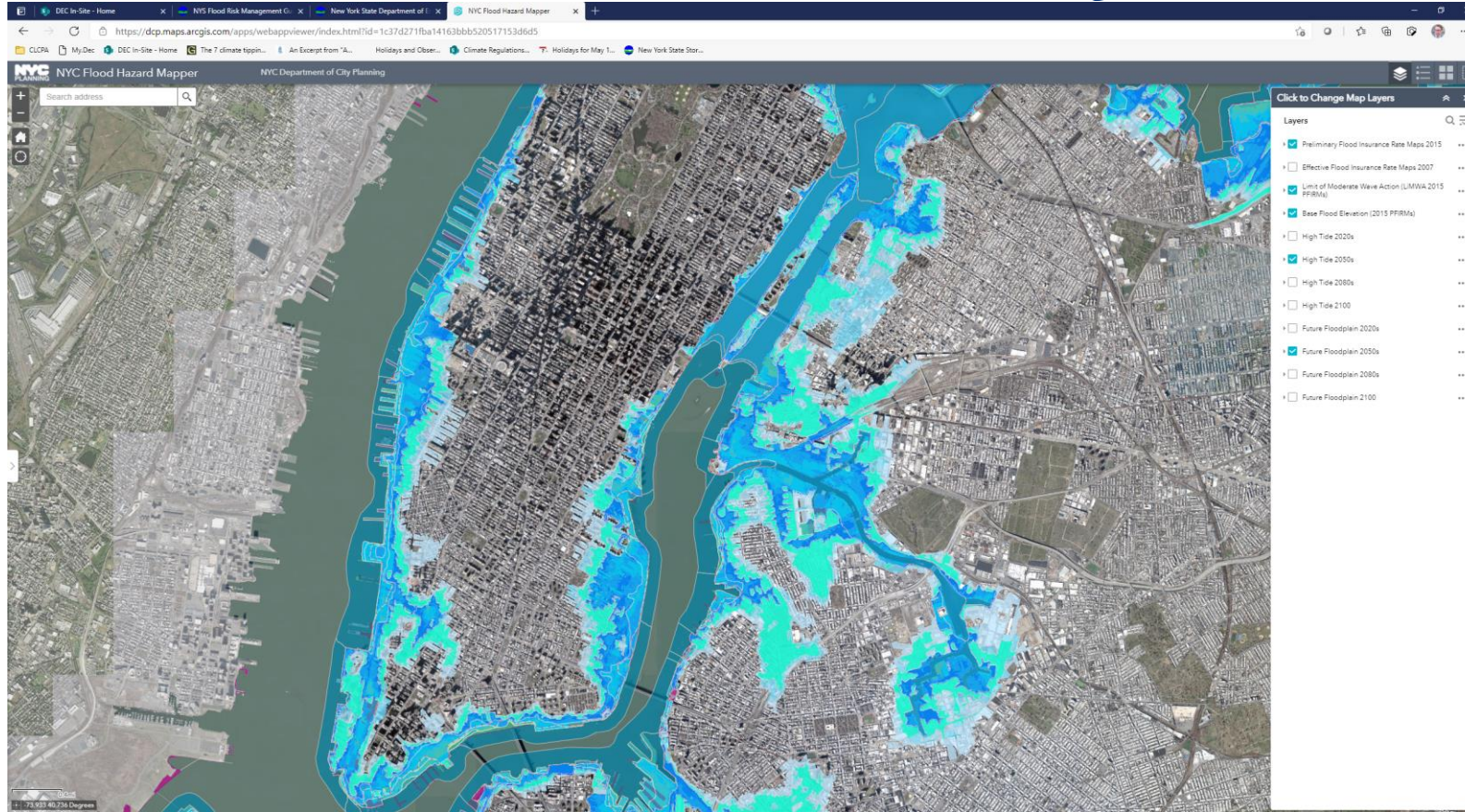


https://services.nysed.gov/SLR_View/



Department of
Environmental
Conservation

Sea-level Rise Viewer: New York City Flood Hazard Mapper



<https://www1.nyc.gov/site/.planning/.data-maps/flood-hazard-mapper.page>

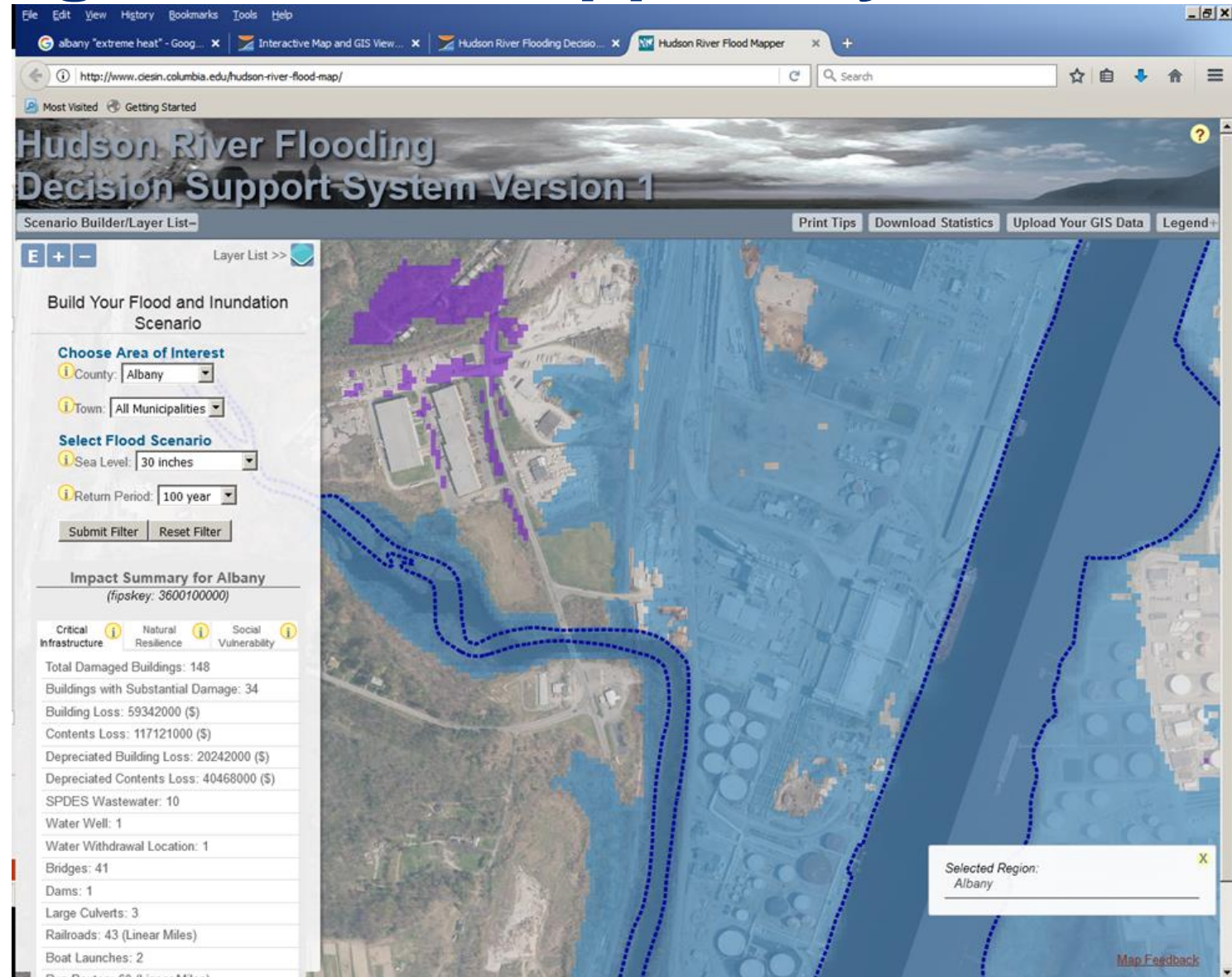


Department of
Environmental
Conservation

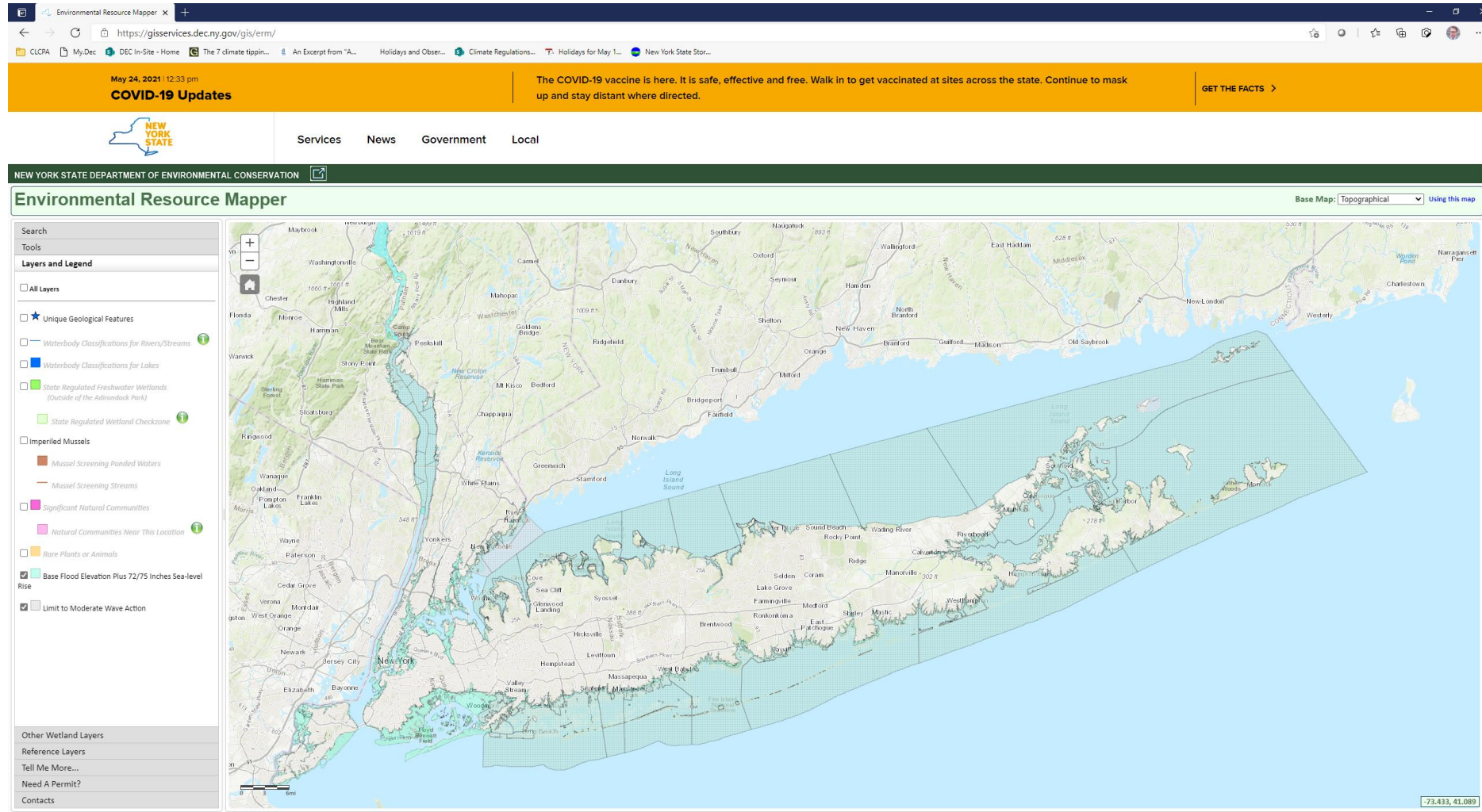
Hudson River Flooding Decision Support System

- Ten Hudson Valley counties
- Dynamic flood modeling of precipitation and SLR
- Statewide system in progress
- Accessible directly or through NYCCSC
- User-selected SLR, return period scenarios
- Natural and human-built asset locations
- Impact summaries

<http://www.ciesin.columbia.edu/hudson-river-flood-map/>



DEC Environmental Resource Mapper SLR Layer



<https://gisservices.dec.ny.gov/gis/erm/>

DOS Coastal Risk Zones



- Factors:
 - Topography
 - Floodplains
 - Storm surge
 - Shallow coastal flooding
 - Susceptible natural features
- Extreme, high and moderate risk areas

<http://opdgig.dos.ny.gov>

National Weather Service Coastal Flooding Page

South Shore of NYC/LI and Eastern LI		
Station	Coastal Flood Benchmarks (MLLW / MHHW / NGVD / NAVD)	Tidal Impacts/Analysis
South Shore Bays		
Rockaway Inlet (USGS) Site ID# 01311875	QNS Minor - 7.3' / 1.8' / 5.5' / 4.4' BKN Minor - 7.8' / 2.3' / 6.0' / 4.9' Moderate - 8.3' / 2.8' / 6.5' / 5.4' Major - 9.3' / 3.8' / 7.5' / 6.4' MLLW - 1.8' = NGVD MLLW - 5.6' = MHHW MLLW - 2.9' = NAVD MHHW + 2.6' = NAVD	Impacts Exceedance Probabilities
Jamaica Bay (USGS) Site ID# 01311850	Qns Minor - 7.5' / 1.6' / 5.5' / 4.4' Moderate - 8.2' / 2.3' / 6.2' / 5.1' Major - 9.0' / 3.1' / 7.0' / 5.9' MLLW - 2.0' = NGVD MLLW - 5.9' = MHHW MLLW - 3.1' = NAVD MHHW + 2.8' = NAVD	Impacts Exceedance Probabilities Coastal Flood Vulnerability
East Rockaway Inlet (USGS) Site ID# 01311145	Minor - 6.0' / 1.0' / 4.5' Moderate - 7.0' / 2.0' / 5.5' Major - 8.0' / 3.0' / 6.5' MLLW - 1.5' = NGVD MLLW - 5.0' = MHHW	Impacts Exceedance Probabilities
Freeport (USGS) Site ID# 01310521	Minor - 6.0' / 1.4' / 4.5' Moderate - 6.5' / 1.9' / 5.0' Major - 7.2' / 2.6' / 5.7' MLLW - 1.5' = NGVD MLLW - 4.6' = MHHW	Impacts Exceedance Probabilities Top 20 list

Rockaway Inlet at Floyd Bennet Field

at 11.6 ft MLLW / 9.8 ft NGVD / 6.0 ft MHHW (10-11pm 10/29/2012)



In southwest Brooklyn; the shoreline communities including [Sea Gate](#), [Coney Island](#), and [Manhattan Beach](#), experienced significant inundation from storm tide and wave action. Numerous homes in this area experienced major structural damage. Inundation extended inland to [Avenue X](#) into [Bensonhurst](#), [Gravesend](#) and [Sheepshead Bay](#), shutting down the Belt Parkway. In southeast Brooklyn, the hardest hit areas were [Gerritsen Beach](#), [Floyd Bennet](#), [Bergen Beach](#), [Mill Basin](#), and [Canarsie](#) due to inundation from Jamaica Bay and Rockaway Inlet several blocks inland.

Across the [Rockaways](#), up to 4 and 7 feet of inundation was exhibited over the peninsula due to surge from Jamaica Bay on the north side and from surge and wave action from the Atlantic Ocean on the south side. Widespread major damage was experienced across the entire length of the Rockaways, with numerous homes and businesses in [Breezy Point](#), [Arverne-Edgemere](#) and [Seaside](#) experiencing complete destruction. Atlantic Ocean facing shoreline structures, such as boardwalks and several oceanfront homes were destroyed due to runup and setup on top of storm tide from high wave action of at least 10 to 15 feet from the Atlantic Ocean.

<https://www.weather.gov/okx/coastalflood>



Department of
Environmental
Conservation

Thank You

Mark Lowery

Assistant Director

Office of Climate Change

New York State Department of
Environmental Conservation

625 Broadway

Albany NY 12233-1030

Mark.Lowery@dec.ny.gov



Connect with us:

- DEC: www.dec.ny.gov
- Community Risk and Resiliency Act:
www.dec.ny.gov/energy/102559.html
- Climate Smart Communities:
www.dec.ny.gov/energy/76483.html
- Facebook: www.facebook.com/NYSDEC
- Twitter: twitter.com/NYSDEC
- Flickr: www.flickr.com/photos/nysdec